PLANT ITEM MATERIAL SELECTION DATA SHEET

R10559885

ISSUED BY
RPP-WTP PDC

CXP-VSL-00026 A/B/C (PTF)
IX Treated LAW Collection Vessel

- Design Temperature (°F)(max/min): 138/40
- Design Pressure (psig) (max/min): 15/FV
- Location: incell
- PJM Discharge Velocity (fps) (max): 40
- Drive Cycle: 17 % (at 40 fps)

Associated items

CXP-PJM-00002 – CXP-PJM-00019

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on sheets 5 and 6

Operating Modes Considered:

- The vessel is filled with alkaline waste.
- The vessel is filled with demineralized water with traces of contract maximum waste.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.04 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- Develop rinsing/flushing procedure for acid and water

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED
PROFESSIONAL ENGINEER
3/29/05
EXPIRES: 12/07/05

Please note that source, special nuclear and byproduct materials, as defined in the Atomic Energy Act of 1954 (AEA), are regulated at the U.S. Department of Energy (DOE) facilities exclusively by DOE acting pursuant to its AEA authority. DOE asserts, that pursuant to the AEA, it has sole and exclusive responsibility and authority to regulate source, special nuclear, and byproduct materials at DOE-owned nuclear facilities. Information contained herein on radionuclides is provided for process description purposes only.

This bound document contains a total of 6 sheets.

1	3/29/05	Issued for Permitting Use			
0	5/20/04	Issued for Permitting Use	DLA	APR	SWV
REV	**DATE**	**REASON FOR REVISION**	**PREPARER**	**CHECKER**	**APPROVER**

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

Vessels receive cesium-depleted LAW and hold the treated LAW while analysis is completed and results reviewed to determine if the batch meets cesium concentration specifications and can be sent on or must be recycled..

a General Corrosion
The vessels will operate between 77 and 113°F. The solutions in the vessels will generally be alkaline.

Hamner (1981) lists a corrosion rate for 304 (and 304L) in NaOH of less than 20 mpy (500 µm/y) at 77°F and over 20 mpy at 122°F. He shows 316 (and 316L) has a rate of less than 2 mpy up to 122°F and 50% NaOH. Sedriks (1996) states that the 300 series are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above Davis (1994) states the corrosion rate for 304L in pure NaOH will be less than about 0.1 mpy up to about 212°F though Sedriks states the corrosion rate data beyond about 122°F is low because of the presence of oxidizers.

In this system, the normal hydroxide concentrations and temperatures are such that 304L stainless steel will be acceptable.

Conclusion:
At temperatures less than about 140°F, 304L is expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. It is thought that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices. Koch (1995) is of the opinion that fluoride will have little effect in an alkaline media.

Because the vessels normally operate below 113°F, 304L stainless steel would be acceptable in the proposed alkaline conditions.

If the vessel were filled with process water and left stagnant, there would be a tendency to pit The time to initiate would depend on the amount of residual chlorides. 316L is considered sufficiently resistant.

Conclusion:
Localized corrosion, such as pitting, is not expected to be a concern under the stated operating conditions. Under those conditions, it is expected that 304L will be satisfactory. However, to allow for the possibility of lower pH conditions during elution, 316L is the recommended alloy.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not expected in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as a few ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below the normal maximum operating temperature. During the normal operation, either 304L or 316L are expected to be satisfactory.

Neither 304L nor 316L are susceptible to caustic cracking at the proposed conditions.

Conclusion:
At the normal, stated, operating environment, either 304L or 316L is acceptable.

e Crevice Corrosion
See pitting.

Conclusion:
See Pitting.

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth if microbes were introduced.

Conclusion:
MIC is not considered a problem.

PLANT ITEM MATERIAL SELECTION DATA SHEET

h Fatigue/Corrosion Fatigue
Not expected to be a concern.

Conclusion:
Not expected to be a concern.

i Vapor Phase Corrosion
The vapor phase portion of the vessel may be contacted with particles of waste. It is unknown whether this will be sufficiently washed or whether residual acids or solids will be present. In the event solids remain, and at the stated chloride concentrations, 316L is the minimum suitable.

Conclusions:
316L is recommended

j Erosion
Based on past experiments by Smith & Elmore (1992), the solids are soft and erosion is not expected to be a concern for the vessel wall. A general erosion allowance of 0.004 inch is adequate for components with solids content less than 2 wt%. No localized protection is necessary for the applicable portions of the bottom head to accommodate PJM discharge velocities of up to 12 m/s for a usage of 100 % operation.

The PJM nozzle requires no additional protection

Conclusion:
The recommended corrosion allowance provides sufficient protection for erosion of the vessel.

k Galling of Moving Surfaces
Not applicable

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not applicable.

n Cavitation
None expected.

Conclusion:
Not believed to be of concern.

o Creep
The temperatures are too low to be a concern.

Conclusion:
Not applicable.

p Inadvertent Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid for a limited period.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
4. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
5. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
6. Smith, H. D. and M. R. Elmore, 1992, *Corrosion Studies of Carbon Steel under Impinging Jets of Simulated Slurries of Neutralized Current Acid Waste (NCAW) and Neutralized Cladding Removal Waste (NCRW)*, PNL-7816, Pacific Northwest Laboratory, Richland, Washington.

Bibliography:

1. Danielson, MJ & SG Pitman, 2000, *Corrosion Tests of 316L and Hastelloy C-22 in Simulated Tank Waste Solutions*, PNWD-3015 (BNFL-RPT-019, Rev 0), Pacific Northwest Laboratory, Richland WA.
2. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
3. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
4. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

PROCESS CORROSION DATA

Component(s) (Name/ID #) Cs IX treated LAW collection (CXP-VSL-00026A/B/C)

Facility PTF

In Black Cell? Yes

Chemicals	Unit[1]	Contract Max		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	3.03E+01	3.05E+01			
Chloride	g/l	1.16E+01	1.40E+01			
Fluoride	g/l	1.38E+01	1.67E+01			
Iron	g/l	2.22E+00	2.50E+00			
Nitrate	g/l	2.14E+02	2.50E+02			
Nitrite	g/l	6.44E+01	7.71E+01			
Phosphate	g/l	4.65E+01	5.45E+01			
Sulfate	g/l	2.47E+01	2.96E+01			
Mercury	g/l	7.26E-02	1.87E-02			
Carbonate	g/l	8.68E+01	9.56E+01			
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2

List of Organic Species:

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. T normal operation 77 °F to 113 °F (same as for CXP-VSL-00001)
3. pH approximately 12 to 14 (same as for CXP-VSL-00001)

Assumptions:

PLANT ITEM MATERIAL SELECTION DATA SHEET

4.3.6 Cs IX Treated LAW Collection Vessels (CXP-VSL-00026A/B/C)

Routine Operations

The Cs IX treated LAW collection vessels (CXP-VSL-00026A, CXP-VSL-00026B, and CXP-VSL-00026C) are designed to collect batches of cesium-depleted LAW. Three vessels are used so that once a vessel is full it can be sampled and then pumped out while other vessels are still receiving or discharging treated LAW. The samples are analyzed and the results are reviewed before determining whether the batch meets cesium concentration specifications and can be sent on or needs to be recycled. A required 24-hour hold time, based on laboratory estimates, is used to ensure that there is adequate time for sampling, analyses (for cesium), and review of results. Each vessel normally receives a continuous flow of cesium-depleted LAW. In normal operations, one of the three vessels will be in a receiving mode, one vessel will be in a sampling/analyses/review mode, while the third vessel will be in a pump-out mode. Each of the three vessels is equipped with level indication (with density correction capability), sampling provisions, and pulse jet mixers for representative sampling of liquid.

Non-Routine Operations that Could Affect Corrosion/Erosion

None identified.